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REDISCOVERY AND HABITAT ASSOCIATIONS OF *PHOTURIS BETHANIENSIS* MCDERMOTT (COLEOPTERA: LAMPYRIDAE)

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Abstract

Photuris bethaniensis McDermott, 1953, is recorded only from Sussex County, Delaware, from the original species description. In 1998 we relocated *P. bethaniensis* near the type locality. From 1998 through 2000, *Photuris bethaniensis* was found exclusively within freshwater interdunal swales occurring within Delaware's backdune depressions. The species was discovered in 7 of 18 swales surveyed within a 25-km stretch of Atlantic shoreline. *Photuris bethaniensis* was most common in swales with dense shrub thickets. The temporal stability of freshwater interdunal swales may be an important factor influencing the distribution of this species.

Photuris bethaniensis McDermott (Coleoptera: Lampyridae) was first collected during 1949 from a grassy area near the Atlantic Ocean north of the town of Bethany Beach, Delaware. During 1951, this species was again collected from this site and an additional site two miles south of Bethany Beach (McDermott 1953). James E. Lloyd (pers. comm.) collected the only additional Delaware specimens during 1968 near Bethany Beach. In spite of limited surveys in New Jersey (McDermott 1953) and Virginia (S. M. Roble pers. comm.), *P. bethaniensis* has not been reported from other Northeastern states. However, Lloyd noted that *P. bethaniensis* may be part of a species complex that occurs within appropriate habitat south to the Florida Everglades (J. E. Lloyd pers. comm.); recently, Lloyd (2000) referred to a ''Florida form'' of *P. bethaniensis*. No other reports of this species have been published. *Photuris bethaniensis* is currently listed as a Delaware State Endangered Species.

McDermott (1953) provided little in regard to the description of the associated habitat where *P. bethaniensis* was first collected other than ''. . . noted over grass in a large vacant area . . .'' and ''. . . flying over the vegetation, largely bayberry [*Myrica cerifera* L.] . . ..'' During 1994, an uncommon natural plant community type, an interdunal freshwater wetland swale, was described from the barrier dunes near the Bethany Beach area (McAvoy and Clancy 1994). Interdunal swales form distinct ecosystems and occur sporadically along the Gulf and Atlantic coasts (Odum and Harvey 1988). Delaware's interdunal swales are seasonally flooded depressions occurring in the backdunes and are usually dominated by herbaceous vegetation; however, many swales also maintain large patches of shrubs comprised of *M. cerifera* and some *Baccharis halimifolia* L. (McAvoy and Clancy 1994). These communities are dynamic systems and are susceptible to saltwater intrusion and shifting sand

formations. The freshwater interdunal swale plant community is of particular conservation interest because of the threats associated with rapid coastal development, sea-level rise, and the invasion of alien plant species. Although McDermott did not note the presence of wetlands, interdunal swales occur in the Bethany Beach area. Prompted by this discovery, we searched for *P. bethaniensis* within these plant communities in several localities along the Delaware coast. Below we summarize the rediscovery and habitat characteristics of *P. bethaniensis* in Delaware.

Methods

Aerial photographs from 1946 were perused in search of sites that may have represented those reported by McDermott (1953). Photos revealed a wetland swale dominated by herbaceous vegetation in the vicinity of where he reported a large colony of *P. bethaniensis*. This wetland has persisted to the present and is now within the boundaries of Fenwick Island State Park. Inventory began here on 24 June 1998, and in the three years of survey work, 18 swales were visited within a 25-km stretch of Delaware's Atlantic shoreline, including swales at Fenwick Island State Park ($n = 4$), Delaware Seashore State Park ($n = 5$), Tower Shores development ($n = 1$), and Cape Henlopen State Park ($n = 8$). Swales ranged in size from less than 100 m^2 to an estimated 5,000 m^2.

Fireflies were captured using a sweep-net and retained for subsequent identification. Throughout the study period, collection dates were from 24 June to 5 August. Initially, we identified our specimens as *P. bethaniensis* using keys presented in McDermott (1958, 1967) and by comparison with the holotype (located at the US National Museum of Natural History, Washington, DC). Specimens were then sent to Dr. James Lloyd, University of Florida, Gainesville, for confirmation. Voucher specimens have been placed in the Department of Entomology, University of Delaware, and Delaware Natural Heritage Program collections.

McDermott (1953) noted an association between *P. bethaniensis* and *M. cerifera*. Therefore, swales were assigned *a posteriori* to one of three broad categories: 1) swales dominated by woody vegetation (estimated >50 percent cover of *M. cerifera* and *B. halimifolia* [hereafter *Myrica-Baccharis*]), 2) *Myrica-Baccharis* shrubs present but not dominant, 3) No *Myrica-Baccharis*. Many of Delaware's swales belong to the *Juncus scirpoides* Lam.-*Scirpus pungens* Vahl. natural community association (McAvoy and Clancy 1994). Thus, herbaceous-dominated swales were separated into two additional categories: 1) Herbaceous-dominated (estimated >50 percent cover) and classified as *J. scirpoides-S. pungens* association (McAvoy and Clancy 1994), and 2) Herbaceous-dominated but plant association not yet classified.

Results and Discussion

We found *Photuris bethaniensis* in 7 of the 18 swales including the swale thought to represent McDermott's ''large colony'' (Fig. 1). Swales occupied by *P. bethaniensis* ranged in size from 500 m^2 to 5,000 m^2. Where they occurred, *P. bethaniensis* were concentrated within freshwater interdunal swales and were rare or absent in surrounding xeric dune meadows and scrub-shrub thickets. We noticed that the species often flew well after sunset, later than sympatric fireflies in the genus *Photinus*. *Photuris bethaniensis* was absent from swales greater than 500 m from the ocean ($n = 4$).

Characteristics of Associated Habitat. Freshwater interdunal swales, like those in Delaware, occur principally on barrier islands that formed during the Holocene Epoch, 2,000 to 5,000 years ago (Kraft and Hiller 1987; Odum and Harvey 1988). They are described by Sneddon *et al.* (1998) as small, very shallow interdunal seasonally flooded

Fig. 1. Freshwater interdunal swale showing herbaceous vegetation amid dense *Myrica-Baccharis* shrubs. A large colony of *P. bethaniensis* was reported from this swale during 1951 and relocated during 1998.

basins, dominated by rushes (*Juncus* sp.). Other co-dominant herbaceous plant species include: *Euthamia tenuifolia* Pursh, *Mikania scandens* L., and *Polygonum* spp. Soils are saturated and are often seasonally inundated with shallow water (usually <50 cm). A shallow organic layer overlies sand and often a freshwater aquifer (Sneddon *et al.* 1998; Odum and Harvey 1988).

In our survey area, freshwater interdunal swales are isolated within a hostile saltwater and xeric dune environment and usually maintain the only freshwater systems in the immediate landscape; nearby wetlands are saltmarsh-associated systems. Swales on the barrier islands of Maryland and Virginia are primarily brackish (*e.g.,* Odum and Harvey 1988; Tyndall and Levy 1978; W. A. McAvoy pers. comm.) potentially limiting the distribution of *P. bethaniensis* in the Mid-Atlantic region. Brackish interdunal swales form a separate type of swale not found in our study area and, in general, are more common along the Atlantic Coast than freshwater swales (Odum and Harvey 1988).

All swales in which we found *P. bethaniensis* included *Myrica-Baccharis* shrub thickets; four swales were dominated by *Myrica-Baccharis*, and three were dominated by the *J. scirpoides-S. pungens* plant association (Table 1). The formation of dense stands of woody vegetation within swales is a gradual process that follows the initial establishment of herbaceous vegetation (Young *et al.* 1995). However, periodically swales may be over-washed with saltwater, temporarily off-setting progression to a shrub-dominated depression. Once shrub thickets have become established they may persist for more than a century before progressing into maritime forest (Young *et al.* 1995). Therefore, at any given time, swales in various stages of development may occur across the barrier island landscape from open herbaceous-dominated swales with little woody vegetation to dense *Myrica-Baccharis* thickets (Young *et al.* 1995). Swales that seemed to maintain the highest numbers of *P. bethaniensis* (pers. obs.) showed evidence of temporal stability as judged by the presence of dense stands of *M. cerifera* and *B. halimifolia* (*e.g.,* Young *et al.* 1995). Temporal stability may be important

Table 1. Distribution of *P. bethaniensis* by categories used to classify 18 freshwater interdunal swales on Delaware barrier islands. Some swales are represented in multiple categories. *Photuris bethaniensis* was found at seven separate swales.

Category	Number of swales occupied by *P. bethaniensis* (total swales sampled)
Myrica-Baccharis	
Dominated by *Myrica-Baccharis*	4 (4)
Myrica-Baccharis present but not dominant	3 (12)
Myrica-Baccharis not present	0 (2)
Herbaceous vegetation	
Herbaceous-dominated and previously classified as *Juncus scirpoides-Scirpus pungens* association	3 (3)
Herbaceous-dominated but plant association not classified	0 (11)

because persistent swales develop a relatively thick organic layer (Jones 1992), which may affect the wetland's suitability for *P. bethaniensis* larvae.

Implications for Conservation. The temporal stability of interdunal freshwater depressions occurring within backdune systems appears to be an important biological contributor to the observed distribution patterns of *P. bethaniensis*. Thus, well-established swales should be targeted first in future inventory efforts. Inventory for *P. bethaniensis* should be undertaken in appropriate habitat throughout the Atlantic Coast and within the interdunal wetlands of the Gulf Coast.

Freshwater interdunal swales are vulnerable to ecological disturbance (Odum and Harvey 1988). Current threats include the loss of habitat from coastal development and the associated lowering of barrier island freshwater aquifers, invasion of aggressive alien plant species, sea-level rise, and the loss of the natural dynamic functions of barrier island ecology. Thus, conservation efforts for *P. bethaniensis* should focus on protecting persistent swales and associated barrier island ecosystems.

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BOOK REVIEW

EVANS, A. V., AND J. N. HOGUE. 2004. **Introduction to California Beetles.** University of California Press, Berkeley, California, 316 pp. Cloth US $39.95, paper US $16.95. Available from the publisher's website: www.ucpress.edu.

Introduction to California Beetles is an attractive, well written, and well-produced introduction to our science. Although it took me a while to get over my preconception that this was intended to be a field guide, I have warmed to the authors' concept, and have come to appreciate what a unique and valuable contribution to the beetle literature Evans and Hogue have produced. The authors have succeeded in covering, in enthusiastic, accessible terms, the breadth of coleopterology, providing nonspecialists with an entry point into its sometimes daunting scope.

The book's chapters vary in focus from region-specific to more general information on beetle biology. After briefly introducing their aims, the authors open with a detailed narrative of human/beetle interactions in California. This interesting, and not entirely familiar story takes in pre-Columbian entomophagy and the scientific tendencies of Russian and Spanish colonizers before covering the more familiar people (LeConte, Horn, Casey, and Fall) and institutions of the late 19th and early 20th centuries. Anyone interested in the development of biological science in western North America will find this section fascinating. The chapter continues with brief discussions of a few more recent workers, following their inspirational stories with a plea to all would-be coleopterists to become involved in continuing their groundbreaking work. Beginning the book with this human story was an unconventional but good choice. It will likely grab many readers who would find beetle anatomy a less exciting place to start.

Two chapters on basic anatomy and life history follow. While quite thorough, and terminologically accurate, these sections read well. Almost every technical detail is accompanied by a humorous or surprising anecdote illustrating the importance of the feature or behavior to the animal. Either a color photograph or a simple, attractive line drawing further illustrates many features. There could have been a few more of these, but the text descriptions are probably sufficiently clear to allow most readers to develop a mental picture. A concise discussion of systematic principles and practice included here conveys simply the rationale behind nomenclature's seemingly counterproductive instabilities.

A chapter on regional biogeography is another unconventional but welcome inclusion. This short section highlights the implications of California's varied topography and climate for its beetle fauna. This topic receives little attention in the nonspecialist literature, but should add greatly to residents' appreciation for their fauna. I would have been interested to see a little attention to how these factors have driven diversification—the focus is mainly on the response of given species to historical environmental shifts. But perhaps that would be delving too deeply into evolutionary esoterica for most readers.

'Beetles of Special Interest' covers a diverse array of topics, including beetles of paleontological, environmental, and economic interest. In all these areas, California's beetles enjoy a relatively high profile, and these include most of the species familiar to the lay person: California's four endangered beetles, as well as pantry, forest, and agricultural pests. In many cases these economically important species are the focus of intense controversy (particularly the role of bark beetles in the declining health of California's coniferous forests), and in general the authors do a good job of distilling the issues down without oversimplifying them. The emphasis here was slightly skewed toward a detrimental perception of beetles, with a lone coccinellid (the Vedalia) representing beneficial beetles. Additional cases found in specific family treatments, such as the successful use of chrysomelids and buprestids in controlling invasive plants, might have been better highlighted here. As it stands this discussion won't move readers much beyond common perceptions. I was particularly disappointed that several beetles attacking eucalyptus in California weren't seen to have any redeeming value. (Non-native eucalyptus is a significant pest to many environmentally minded Californians.)

The heart of the book lies in treatments of twenty-three families of beetles found in the state. These are largely the most conspicuous groups, with a couple of interesting exceptions (Pleocomidae and Phengodidae) to appeal to the more serious readers. Basic biology, California diversity and diagnostic characters of adults and larvae are included for each, as is one of the authors' beautiful photographs (all of living adults). A list of 'similar families' along with differentiating characters is also given under each family. Although the descriptions and differentiating characters are fairly extensive, and certainly accurate, I don't see many newcomers using these to successfully identify specimens, unless they happen to match the photographs. The details requiring magnification to see are too many, as are the exceptions. Nonetheless, the descriptions and photographs together should let the reader form a decent mental image of each family's gestalt.

A thorough chapter on 'Studying Beetles' covers all a beginner will need to know to become a skilled coleopterist. It includes detailed discussion of the basics: collecting, preparation, and rearing methods, an appropriate discussion of the ethics and legalities of collecting, tools and methods of beetle photography, and again, an appeal to all newcomers to get excited, get involved, and share what they learn with others. This fine book will motivate and empower many to do just that.

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